

Final Report for the Long Term Space Astrophysics Grant "The Study of Clusters of Galaxies and Large Scale Structures"

The Long Term Space Astrophysics Grant "The Study of Clusters of Galaxies and Large Scale Structures", NAGW-2508, has been completed. Many research projects have been initiated and completed under support of this program. The results are summarized below.

The work on the ROSAT Deep Survey has been successfully completed. A number of interesting results have been established within this joint MPE, Cal Tech, JHU, ST ScI, ESO collaboration. First, a very large fraction, 70-80 percent, of the X-ray background has been directly resolved into point sources. We have derived a new log N-log S for X-ray sources and have measured a source density of 970 sources per square degree at a limiting flux level of 10^{-15} erg s⁻¹cm⁻² (0.5-2.0 keV). Care was taken in these studies to accurately model and measure the effects of sources confusion. This was possible because of our observing strategy which included both deep PSPC and HRI observations.

From a complete ROSAT Deep Survey sample of 50 objects to a flux limit of $5.5 \cdot 10^{-15}$ erg s⁻¹cm⁻² (0.5-2.0 keV) we have established that 78 percent of the XRB are AGN, 8 percent are groups, 2 percent are galaxies and 6 percent are stars, with 6 percent remaining unidentified. This is the highest fraction of identified objects in a high sensitivity X-ray survey to date. No evidence of a population of narrow emission line galaxies has been established but some evidence for the evolution of low luminosity AGN (Seyfert galaxies) has been reported.

The work on the ROSAT All Sky Survey Northern Cluster Survey has been substantially concluded but the publication of the list has been held up by the need to analyze newly re-calibrated data. This should result in publication over the next year. During the past year we have submitted a paper to the Astrophysical Journal which utilized a sample of clusters originally selected from the ROSAT All-sky survey at redshifts greater than 0.3. This sample was studied with ASCA to determine temperature and luminosity. This sample was then compared to a low redshift sample and the density of the universe, q_0 , was measured. The result is that q_0 is consistent with an open universe, a result that is consistent with the recent observations on Type Ia supernova by Perlmutter et al (1997) and Garnavich et al (1998).

In the last year of the project we initiated work on a number of aspects of the Origins program and in particular I participated in the design and development of the Next Generation Space Telescope. A number of scientific papers emerged including an analysis of the use of a sub-scale NGST to perform a large area, high sensitivity near infrared survey, calculations demonstrating how the NGST could discover and characterize a large number of exo-zodiacal discs, and a separate paper discussing how a small interferometer could be used for both zodiacal disc studies and discovery of large Jupiter like planets.

I include below a bibliography of papers which report on work supported in part by the LTSA program. In addition, I attach four recent papers written with partial support from this program.

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